

PATENT ABSTRACTS OF JAPAN

(11)Publication number : **10-334922**

(43)Date of publication of application : **18.12.1998**

(51)Int.Cl. **H01M 4/86**
H01M 8/02

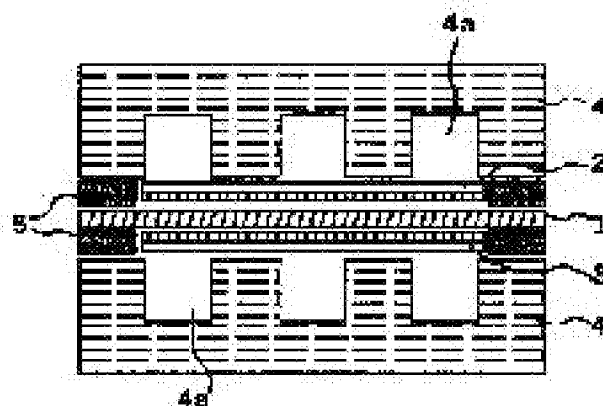
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(54) SOLID HIGH POLYMER FUEL CELL AND ITS MANUFACTURE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a high-performance solid high polymer fuel cell by arranging a hydrogen electrode and an oxygen electrode made of a gas diffusion layer and a catalyst layer across an electrolyte film made of a solid high polymer material, and containing a proton shift acceleration power generation initial stage characteristic increasing agent at least in the catalyst layer on the oxygen electrode side.

SOLUTION: An electrolyte film 1 made of a solid high polymer material is pinched from both faces by a hydrogen electrode 2 and an oxygen electrode 3 laminated with a gas diffusion layer and a catalyst layer on the catalyst layer side respectively, collectors 4 having gas feed grooves 4a are arranged on the outer faces, and gas seal bodies 5 are provided and sealed to obtain a solid high polymer fuel cell. At least a catalyst layer on the oxygen electrode side contains a power generation initial stage characteristic increasing agent which accelerates the proton shift in it and increasing the power generation initial stage characteristic or a water holding agent capable of holding moisture of 1-10 mg/cm². Sulfuric acid, phosphoric acid, or their



compounds are preferably used for increasing an agent or water-holding agent, and at least the oxygen electrode 3 can be impregnated and contained with it.

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CLAIMS

[Claim(s)]

[Claim 1]An electrolyte membrane which consists of solid polymer material.

A hydrogen pole and an oxygen pole which comprise lamination with a gas diffusion layer and a catalyst bed, and pinch said electrolyte membrane in this each catalyst bed side.

This each pole charge collector.

It is the polymer electrolyte fuel cell provided with the above, and said catalyst bed by the side of said oxygen pole at least contains a power generation initial characteristic rise agent which stimulates a proton shift in the catalyst bed concerned, and raises a power generation initial characteristic.

[Claim 2]An electrolyte membrane which consists of solid polymer material.

A hydrogen pole and an oxygen pole which comprise lamination with a gas diffusion layer and a catalyst bed, and pinch said electrolyte membrane in this each catalyst bed side.

This each pole charge collector.

It is the polymer electrolyte fuel cell provided with the above, and said catalyst bed by the side of said oxygen pole at least contains a water retention agent which can hold a moisture content of the range of 1-10 (mg/cm²).

[Claim 3]A polymer electrolyte fuel cell characterized by said power generation initial characteristic rise agent or said water retention agent being sulfuric acid, a sulfated compound, phosphoric acid, or a phosphoric acid compound in claim 1 or claim 2.

[Claim 4]In a manufacturing method of a polymer electrolyte fuel cell which pinches and produces an electrolyte membrane which consists of solid polymer material in each this catalyst bed side of a hydrogen pole and an oxygen pole which laminated and formed a gas diffusion layer and a catalyst bed, respectively, A manufacturing method of a polymer electrolyte fuel cell impregnating with a power generation initial characteristic rise agent which urges a proton shift in said catalyst bed to said oxygen pole, and raises a power generation initial characteristic at least, or a water retention agent which can hold a moisture content of the range of 1-10 (mg/cm²).

[Claim 5]A manufacturing method of a polymer electrolyte fuel cell adjusting said amount of being impregnated of said power generation initial characteristic rise agent or said water retention agent in claim 4 according to water-repellent strength which said catalyst bed has.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to a polymer electrolyte fuel cell and its manufacturing method, and relates to a solid polymer electrolyte type hydrogen-oxygen system fuel cell especially.

[0002]

[Description of the Prior Art]As a typical thing of the polymer electrolyte fuel cell of conventional technology, there is a hydrogen-oxygen system fuel cell and this fuel cell, It comprises two charge collectors, an electrolyte membrane (solid polyelectrolyte membrane or an electrolyte membrane is called hereafter) which consists of solid polymer material, two electrodes which sandwich an electrolyte membrane, and a means to supply hydrogen and oxygen as fuel. Two electrodes are constituted including a catalyst, the carrier which supports this catalyst, the proton conductor which consists of the same solid polymer material as the above-mentioned electrolyte membrane, and the binder which hardens these. And electrochemical reaction expressed with two electrodes, a hydrogen pole and an oxygen pole, like the following chemical formula is performed, respectively.

[0003]That is, in a hydrogen pole, a hydrogen content child is ionized from the hydrogen gas supplied to the hydrogen pole, it becomes a proton (hydrogen ion H^+), and electrons are emitted. $H_2 \Rightarrow 2H^+ + 2e^-$

(** 1) proton conducts the gas diffusion layer and catalyst bed by the side of a hydrogen pole, reaches an electrolyte membrane, further, moves in the inside of an electrolyte membrane, and moves to the opposite oxygen pole side. On the other hand, the emitted electron moves to an oxygen pole through an external circuit. The electron which carried out external movement with the proton which carried out intra plant transfers to the oxygen gas supplied to the oxygen pole like a following formula by the catalyst bed in an oxygen pole reacts, and it is $O(1/2)_2 + 2H^+ + 2e^- \Rightarrow H_2O$ (** 2)

Eventually, water is generated.

[0004]The reaction process of the above-mentioned fuel cell mainly consists of the following four stages. That is, they are the conduction in the inside of the reaction in the catalyst bed (catalyst surface) in the diffusion to the catalyst surface of (A) hydrogen and oxygen, the (B) hydrogen pole, and an oxygen pole, the inside of two poles of the (C) proton, and an electrolyte membrane, and discharge of (D) water. It has become clear that the grade of diffusion of the fuel gas in each stage and the grade of reaction velocity influence the cell output characteristic greatly. And in the above-mentioned (A) stage, the art which adopts the wave type charge collector for performing efficiently supply to the catalyst

surface of fuel and diffusion is indicated by JP,60-35472,A. Using the carbon plate which has a rectangle slot for JP,3-102774,A and JP,2-86071,A is proposed. Contact to an electrode the carbon plate which has these wave type charge collectors and rectangle slots, a contact surface is made to produce space, fuel is diffused in an electrode surface through this space, and a certain amount of output is revealed.

[0005] Usually, with a polymer electrolyte fuel cell, the above structures are adopted, and in order that the above-mentioned (** 2) formula may follow the proton which has passed the electrolyte membrane by the interface of an electrolyte membrane and an oxygen pole, water is generated by an oxygen pole interface. With this produced water, it makes it easy to make a proton reach the active ingredient inside an oxygen pole catalyst bed.

[0006]

[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional technology, even if the proton conductor fully existed in the catalyst bed, the amount of moisture possession in early stages of power generation in the inside of an oxygen pole (catalyst bed) became a narrow path, and the solution technical problem remains in the point that battery capacity is not revealed in the early stages of power generation. Therefore, the purpose of this invention cancels an aforementioned problem and there is in providing the manufacturing method of a highly efficient polymer electrolyte fuel cell and this polymer electrolyte fuel cell.

[0007]

[Means for Solving the Problem] The feature of a polymer electrolyte fuel cell by this invention which attains the above-mentioned purpose, In a polymer electrolyte fuel cell provided with a hydrogen pole and an oxygen pole which comprise lamination with an electrolyte membrane which consists of solid polymer material, and a gas diffusion layer and a catalyst bed, and pinch said electrolyte membrane in this each catalyst bed side, and this each pole charge collector, There is said catalyst bed by the side of said oxygen pole at least in containing a power generation initial characteristic rise agent which stimulates a proton shift in the catalyst bed concerned, and raises a power generation initial characteristic. Said catalyst bed by the side of said oxygen pole at least has other features in a place containing a water retention agent which can hold a moisture content of the range of 1-10 (mg/cm²).

[0008] On the other hand, a manufacturing method of a polymer electrolyte fuel cell by this invention which attains the purpose, In a manufacturing method of a polymer electrolyte fuel cell which pinches and produces an electrolyte membrane which consists of solid polymer material in each this catalyst bed side of a hydrogen pole and an oxygen pole which laminated and formed a gas diffusion layer and a catalyst bed, respectively, It impregnates with a power generation initial characteristic rise agent which urges a proton shift in said catalyst bed to said oxygen pole, and raises a power generation initial characteristic at least, or a water retention agent which can hold a moisture content of the range of 1-10 (mg/cm²).

[0009] According to this invention, since a predetermined moisture content which promotes a proton shift in early stages of power generation is beforehand contained in a catalyst bed, a shortage of a proton shift in early stages of power generation by shortage of moisture is avoided, and a highly efficient battery characteristic can be obtained from early stages of power generation.

[0010]

[Embodiment of the Invention] Hereafter, an embodiment of the invention is described, referring to drawings. Drawing 1 is a type section figure showing the polymer electrolyte fuel cell of one example

by this invention. The section of fundamental battery structure is shown. Drawing 2 is an electrolyte membrane of drawing 1, and an enlarged drawing of each electrode section. It explains referring to drawing 1 and drawing 2 simultaneously. In a figure, the polymer electrolyte fuel cell of this example comprises a layered product of the electrolyte membrane 1 which consists of solid polymer material, the hydrogen pole 2 as two electrodes and the oxygen pole 3 which were provided so that this electrolyte membrane 1 might be pinched from both sides, both the charge collectors 4 allocated in the outside of each of this electrode, and the gas-seal object 5. Both the charge collectors 4 have two or more gas supplying grooves 4a, and hydrogen gas and oxygen gas according to each electrode are supplied to this gas supplying groove 4a. Both charge collector 4 comrades which face across the electrolyte membrane 1, the hydrogen pole 2, and the oxygen pole 3 are the composition of having contacted at the end, and the gas-seal object 5 having been formed in this contact part, and having prevented the leakage of each gas.

[0011]In drawing 2, it is ***** about the lamination arrangement relationship of the hydrogen pole 2 of this example, the electrolyte membrane 1, and the oxygen pole 3. The hydrogen pole 2 consists of the catalyst bed 6 and the gas diffusion layer 7 (it acts as an electronic conductor) by the side of a hydrogen pole, and the oxygen pole 3 consists of the catalyst bed 8 and the gas diffusion layer 9 (it acts as an electronic conductor) by the side of an oxygen pole. And the gas diffusion layers 7 and 9 can mold, sinter and obtain carbon fiber, for example. The active ingredient which functions as a catalyst to which each catalyst beds 6 and 8 urge a reaction with hydrogen gas and oxygen gas which were supplied, It comprises a carrier which supports this active ingredient, a proton conductor for conducting a proton, the power generation initial characteristic rise agent or water retention agent mentioned later, and a binder which hardens these. And unification composition of the gas diffusion layer 7, the catalyst bed 6, the electrolyte membrane 1, the catalyst bed 8, and the gas diffusion 9 is carried out in piles.

[0012]That is, that the power generation initial characteristic rise agent or the water retention agent is contained in both the catalyst beds of the catalyst bed of an oxygen pole or an oxygen pole, and a hydrogen pole has the composition by which it is characterized [of the polymer electrolyte fuel cell by this invention]. If it puts in another way, when the catalyst bed 6 by the side of the hydrogen pole 2 of this example and the catalyst bed 8 by the side of the oxygen pole 3 contain the power generation initial characteristic rise agent or water retention agent mentioned later, the proton shift in the hydrogen pole 2 will be promoted, and. The proton shift from the electrolyte membrane 1 in the oxygen pole 3 is made easy, by using effectively the catalyst function of the active ingredient of the oxygen pole 3, the proton shift of two poles is improved, a power generation initial characteristic is raised, and stabilization of the battery capacity as the whole is attained.

[0013]Next, content of the power generation initial characteristic rise agent by this invention and a water retention agent is explained. On these specifications, a power generation initial characteristic rise agent and a water retention agent are called water retention agent etc. First, the method of making a water retention agent etc. stick to a catalyst bed about the content methods, such as a water retention agent (impregnated) is effective (that is, the present manufacturing process can divert as it is, and is effective in respect of productivity). As a point which this adsorption method takes into consideration, there are concentration of time, a water retention agent, etc. which are made to stick to a catalyst bed, strength of the water repellence of a catalyst bed further, etc. The simple adsorption method of these fixes binder concentration (water-repellent strength) and concentration of a water retention agent etc., is adjusted and is made to adsorb only in adsorption time. It is effective for sulfuric acid or a sulfate compound etc.

which has a sulfonic group to carry out construction material of electrolyte membranes, such as to make construction material of a water retention agent etc. into the same construction material as an electrolyte membrane, for example, a water retention agent etc., and, and to serve as construction material from a point of productivity.

[0014]Water retention agent isoconcentration has the good range of 1M (mol)-3M (mol), and the content of the moisture of a water retention agent etc. has the good range of 1-10 (mg/cm²). It turned out at the practical point that the range of 3-6 (mg/cm²) is preferably good. That is, it is because it does not succeed that it is below one (mg/cm²) in an improvement of a power generation initial characteristic, and the fine pores of a catalyst bed will blockade and it similarly will not succeed in an improvement of the characteristic, if 10 (mg/cm²) is exceeded. And it is because it will succeed in an improvement of a power generation initial characteristic certainly if it is more than three (mg/cm²), and the anxiety of a fine-pores blockade will be avoided if it is below six (mg/cm²). Since the catalyst bed of conventional technology has strong water repellence, at present, what the content of the moisture has and exceeds 1 (mg/cm²) is not seen. [few]

[0015]Next, the relation between content, such as a water retention agent to a catalyst bed, and the water repellence of a catalyst bed is explained. There are the method of performing by changing the absolute magnitude of the binder which has the water repellence added to a catalyst bed, and the method of performing by changing the mixture ratio of each binder in which water-repellent strength differs in water-repellent strength control. It has the feature that the former can control water repellence, without changing the pore structure of a catalyst bed. Although the latter changes some pore structures of a catalyst bed, the feature is at a point practical about being simple. As a water-repellent binder, fluoro-resins, such as polytetrafluoroethylene (it abbreviates to PTFE hereafter), the graphite fluorides represented with (CF) n, or those mixtures are used.

[0016]However, a water-repellent binder cannot be included so much from it being a kind of a resistor electrically. for example, when a water-repellent binder is PTFE, the quantity receives the whole quantity of each catalyst bed of a hydrogen pole and an oxygen pole -- about an oxygen pole. 10-40 (% of the weight) -- it is 10-30 (% of the weight) preferably -- a hydrogen pole -- 20-50 (% of the weight) -- it is 20-40 (% of the weight) preferably. And it has become clear that it is more desirable than the quantity of the water-repellent binder of an oxygen pole to make [many] it more than ten (% of the weight) in the difference as for the quantity of the water-repellent binder of a hydrogen pole. Other water-repellent binders are estimated to be the range of the same quantity as the above.

[0017]By the way, although it is hydrophilicity-like [the ion exchange group of a proton conductor], other portions are not necessarily hydrophilicity-like and change with selection materials. Therefore, the addition effect of a proton conductor is not a forge fire which endures a binder. And if an addition increases, a hydrophilic group will increase, and hydrophilic nature will increase certainly, but since a proton conductor exists as a film inside a catalyst bed, when a proton conductor is added so much, there is a possibility of blockading catalyst fine pores. Therefore, many cannot be added, but it is necessary to select the material of a proton conductor appropriately, and is the quantity of a proton conductor, and it is difficult to control water repellence. And the proton conductor for adding to a catalyst bed and aiming at expansion of effective reaction surface area can be said to be especially preferred [high perfluoro sulfonic acid type resin or perfluoro carboxylic resin of chemical stability, etc.] for the severe service condition of touching oxidation and reducing atmosphere.

[0018]On the other hand, the coating method is [production of the electrode] suitable. Namely, the active ingredient as a catalyst and the carbon as a carrier which supports this active ingredient, It is the method of mixing a proton conductor and a water-repellent binder beforehand, preparing the paint of a catalyst bed, applying this catalyst bed to a gas diffusion layer, carrying out laminating formation of a gas diffusion layer and the catalyst bed, respectively, and producing a hydrogen pole and an oxygen pole. Therefore, when diverting this method and producing the electrode by this invention, as mentioned above, the water repellence of an electrode shall adjust the addition of a water-repellent binder, and shall select it arbitrarily, and the amounts of being impregnated, such as a water retention agent, shall be decided after that according to the water-repellent strength of an electrode which is dependent on the quantity of this water-repellent binder.

[0019]That is, the addition of a binder is lessened and water repellence of a catalyst bed is made into weakness to increase content (namely, the amount of being impregnated), such as a water retention agent. On the other hand, the addition of a binder is increased and water repellence of a catalyst bed is made into strength to lessen content, such as a water retention agent. That is, it can be said that preparation of content, such as a water retention agent, can be arbitrarily performed with the addition of a water-repellent binder, and can divert the present manufacturing process as it is. 2 of the typical thing which artificers examined, and the example of 3 are shown hereafter, and the details of this invention are explained. However, an example does not have these things [being limited to seeing]. That is, this invention is broadly applied to the composition of the art etc. which are indicated.

[0020]

[Example]Hereafter, a concrete example is described.

[Example 1] Two electrodes were carried out like the next as the almost same structure and construction material, and the catalyst bed and gas diffusion layer of the hydrogen pole of Example 1 and the oxygen pole produced them. Namely, the carbon powder as a carrier which supports platinum and this platinum as an active ingredient for a catalyst bed, kneading preparation of perfluoro sulfonic acid system cation exchange resin (the product made by Aldrich Chemical, Nafion liquid) as a proton conductor and the drainage system suspension of PTFE as a water-repellent binder is fully carried out -- the catalyst bed paste was produced. The gas diffusion layer applied the drainage system suspension of PTFE to the carbon paper of the pole diameter about 100 (micrometer) thickness 100 (micrometer) at a rate of the PTFE coverage 12 (mg/cm²), and calcinated and produced it by 350 (**) to it.

[0021]And the above-mentioned catalyst bed paste was applied and laminated to this gas diffusion layer, it was dried by 80 (**), and the two-electrodes base was produced. then, the whole (electrode area ² of 9 cm) two-electrodes base of them is received -- impregnated with the sulfuric acid solution of 1M (mol) at a rate of 5 (mg/cm²), namely, the catalyst bed was made to contain a water retention agent etc., and the hydrogen pole and the oxygen pole were produced. In this example, as mentioned above, an active ingredient, a carrier, and a proton conductor, Carry out kneading preparation of the binder, once produce a paste state catalyst bed, after that, apply and harden this catalyst bed to the carbon paper as a gas diffusion layer, etc., produce an electrode substrate, and the electrode substrate of this gas diffusion layer and catalyst bed is dipped in sulfuric acid, A catalyst bed is made to contain a water retention agent (namely, a power generation initial characteristic rise agent or a water retention agent) etc. If it puts in another way, it can be said that it is the "indirect content method to the catalyst bed of moisture" of making a catalyst bed (it is a proton conductor to the Lord) holding moisture. And it can be said that it is an effective method since the present production process is diverted as it is and the described method

can perform it.

[0022]Namely, the feature of the manufacturing method of the polymer electrolyte fuel cell by this invention, In the manufacturing method of the polymer electrolyte fuel cell which pinches and produces the electrolyte membrane which consists of solid polymer material in each this catalyst bed side of the hydrogen pole and oxygen pole which laminated and formed the gas diffusion layer and the catalyst bed, respectively, It is in the point of impregnating with the power generation initial characteristic rise agent which urges the proton shift in a catalyst bed to an oxygen pole, and raises a power generation initial characteristic at least, or the water retention agent which can hold the moisture content of the range of 1-10 (mg/cm²).

[0023]It was referred to as presentation [of a concrete hydrogen pole], platinum 0.3 (mg/cm²), carbon powder 0.97 (mg/cm²), proton conductor 30 (% of the weight), and PTFE30 (% of the weight). The presentation of the oxygen pole was set to platinum 0.3 (mg/cm²), carbon powder 0.97 (mg/cm²), proton conductor 20 (% of the weight), and PTFE20 (% of the weight). In the electrolyte membrane which consists of solid polymer material, it is a product made by Du Pont. Nafion 117 was used. and it allots so that an electrolyte membrane may be pinched in each catalyst bed side of a hydrogen pole and an oxygen pole -- with the pressure of hot pressing (kg/cm²), i.e., 100, it pressed for 15 minutes, and pasted up at the temperature 120 (**), and the single cell was created. On the other hand, in order to compare with this example, both a hydrogen pole and an oxygen pole Platinum 0.3 (mg/cm²), it is considered as the same presentation with carbon powder 0.97 (mg/cm²), the proton conductor 20 (% of the weight), and PTFE20 (% of the weight) -- what being impregnated of sulfuric acid does not have in these two electrodes, i.e., a water retention agent, made the thing which is not made to contain, and the single cell equivalent to a conventional example was created.

[0024]Each single cell created as mentioned above was incorporated as a cell, and the current density-voltage characteristic of each of this cell was measured on conditions (80 ** and 1 atmosphere). The result is shown in drawing 3. Drawing 3 is a figure showing the lapsed time of the fuel cell of one example and the relation of voltage by this invention. the initial performance of the cell using the electrode of the conventional example shown in a figure -- initial voltage shows the voltage 0.52V (average) in the 500 (mA/cm²) time of current density. On the other hand, it became clear that the characteristic that initial voltage is 0.62V (average) in the initial performance of the cell using the electrode of this example was shown in the 500 (mA/cm²) time of current density. Thus, the power generation initial characteristic of the polymer electrolyte fuel cell was able to be raised by having composition like this example which contains a water retention agent etc. beforehand in an oxygen pole and a hydrogen pole.

[0025][Example 2] Although the composition of Example 2 is almost the same as that of Example 1, in order only for the amounts of being impregnated, such as a water retention agent, to differ and to make a catalyst bed contain a water retention agent etc., it impregnates the sulfuric acid solution 5 (mg/cm²) of 3M (mol) with an electrode substrate. The relation of the lapsed time and voltage which show the battery capacity of Example 2 was the same as that of the result of Example 1 shown in drawing 3 almost. The initial performance of the cell in the case of this example 2 and the initial voltage at the 500 (mA/cm²) time of current density showed the characteristic exceeding 0.60V. Even if it raised water retention agent isoconcentration like this example 2, battery capacity was able to be substantially raised by impregnating an oxygen pole and a hydrogen pole beforehand.

[0026][Example 3] The composition of Example 3 is the composition which made the porosity of the oxygen pole higher than a hydrogen pole. That is, the electrode in case porosity differs in the gas diffusion layer of a hydrogen pole and an oxygen pole and each catalyst bed between electrolyte membranes was produced. The catalyst bed of two electrodes was made two-layer, respectively. The 1st-layer paste by the side of the gas diffusion layer of one catalyst bed of a hydrogen pole supported the platinum catalyst with the carrier of the carbon of the mean particle diameter 3 (micrometer), and kneaded and obtained ion-exchange resin (perfluoro sulfonic acid type resin) of 30 (% of the weight), and PTFE of 40 (% of the weight). The 2nd-layer paste by the side of the electrolyte membrane of the catalyst bed of a hydrogen pole presupposed that it is the same as Example 1. And these pastes were applied to the carbon paper as a gas diffusion layer two-layer, and were dried by 80 (**), and the hydrogen pole was produced.

[0027]The 1st-layer paste by the side of the gas diffusion layer of the catalyst bed of an oxygen pole of another side supported the platinum catalyst with the carrier of the carbon of the mean particle diameter 6 (micrometer), and kneaded and obtained ion-exchange resin (perfluoro sulfonic acid type resin) of 20 (% of the weight), and PTFE of 30 (% of the weight). The 2nd-layer paste by the side of the electrolyte membrane of the catalyst bed of an oxygen pole presupposed that it is the same as Example 1. And these ** -strikes were applied to carbon paper two-layer, and were dried by 80 (**), and the oxygen pole was produced. The making process of after that except the above-mentioned composition is the same as Example 1.

[0028]Drawing 4 is a figure showing the current density of the fuel cell of Example 3 and the relation of voltage by this invention. a figure -- setting -- as for it, when compared in the point of the current density 500 (mA/cm²), the battery capacity of this example turned out to the cell voltage of a conventional example being at least 0.60V that cell voltage is at least 0.65V. Compared with the conventional example, the battery capacity of this example was also understood that it excels in the point of current density [the broad range]. If it puts in another way and will be the same voltage, it can be said that the output of high current density is obtained. Thus, battery capacity was able to be improved by composition which makes the porosity of an oxygen pole higher than a hydrogen pole. As mentioned above, activation of an oxygen pole and a hydrogen pole can be attained from the conventional thing, and, as a result, the polymer electrolyte fuel cell by this invention can be substantially improved in a cell output.

[0029]It will be as follows if the above is summarized. Namely, the polymer electrolyte fuel cell by this invention, Consist of the hydrogen pole and oxygen pole which are electrodes provided so that solid polyelectrolyte membrane and its electrolyte membrane might be pinched, and a means to supply hydrogen gas and oxygen gas to a hydrogen pole and an oxygen pole, respectively, and this electrode, In the polymer electrolyte fuel cell which consists of a catalyst bed which consists of carbon support, the active ingredient supported by it, a proton conductor, and a water-repellent binder, and an electronic conductor which is in the outside and serves as a gas diffusion layer, To this catalyst bed, the water retention agent etc. were added beforehand, and it was made the damp or wet condition at it.

[0030]The water retention agent of the catalyst bed of each electrode, etc. are controlled by this invention under a certain specific condition.

Therefore, the battery capacity of a polymer electrolyte fuel cell can be raised.

In this invention, content, such as a water retention agent, changes with water repellence of an electrode. Therefore, the hydrogen pole side when water repellence is higher than the oxygen pole side, Since the

water retention agent concerned etc. can serve as a proton conductor if content, such as a water retention agent, is increased and there are water retention agents of enough in both an oxygen pole and a hydrogen pole in the oxygen pole rather than this hydrogen pole, it can be said that there may not be any proton conductor.

[0031]The catalyst bed of the hydrogen pole of this example and the two poles of an oxygen pole consists of carbon support, the active ingredient (catalyst) supported by it, a proton conductor, and a water-repellent binder. And an active ingredient has platinum or a platinum metal, for example, rhodium, a ruthenium, palladium, and preferred iridium, and the construction material of a proton conductor may be the same solid polymer electrolyte as an electrolyte membrane, and may differ. Fluoro-resins, such as polytetrafluoroethylene, the graphite fluorides which are expressed with the chemicals molecular formula $(CF)_n$, or those mixtures of a water-repellent binder are effective. It can be said that the sulfuric acid and sulfate compound of water retention agents which have the material of an electrolyte membrane and a sulfonic group as which it can serve are good from points, such as productivity. The electrolyte membrane applied to this invention is generally a membranous gestalt. The solid polymer electrolyte resin like perfluoro sulfonic acid type resin and par FURUO carboxylic resin of the construction material generally used is preferred.

[0032]It will be as follows if it explains supplementarily. In the conventional polymer electrolyte fuel cell, in order to promote the prevention from dry of an electrolyte membrane, and movement of a proton in a hydrogen pole, moisture is added. About an oxygen pole, although a catalyst bed is water repellence, there are some which are being humidified. Even if it is a case where it humidifies, since the catalyst bed of conventional technology has strong water repellence, at present, what the content of the moisture has and exceeds $1 \text{ (mg/cm}^2\text{)}$ is not seen. [few] That is, in order to both promote movement of a proton required for the electrode reaction in a catalyst bed in both the catalyst beds of a hydrogen pole and an oxygen pole, a certain amount of moisture must exist. However, since there is work of diffusion of hydrogen gas in the hydrogen pole side and the connection with a proton and moisture is promoted, When compared with the oxygen pole side, the moisture dependence was small, therefore the water capacity of the moisture by the side of an oxygen pole rather became a narrow path, movement of the proton was spoiled, and there was a point that the battery capacity which shows a high power generation initial characteristic could not be revealed.

[0033]On the other hand, in the polymer electrolyte fuel cell by this invention, . Contain the water retention agent etc. which can hold the predetermined moisture content for urging the proton shift in a catalyst bed to both the catalyst beds of the catalyst bed of an oxygen pole or a hydrogen pole, and an oxygen pole beforehand, and raising a power generation initial characteristic. (That is, the power generation initial characteristic rise agent which stimulates the proton shift in a catalyst bed and raises a power generation initial characteristic is contained) By things, movement of the proton by the shortage of moisture in early stages of operation is made easy, and the target battery capacity is made to reveal. And when many things are examined, the content of the moisture of a water retention agent which makes moisture hold acquires knowledge with desirable it being the range of $1\text{-}10 \text{ (mg/cm}^2\text{)}$.

[0034]The requirements desired as a power generation initial characteristic rise agent are dissociating (1) proton (hydrogen ion H^+), not invading (2) active ingredients (platinum, a ruthenium, etc.), and not blockading the fine pores in (3) catalyst beds (don't exist in solid form).

There is sulfuric acid or a sulfated compound, phosphoric acid, or a phosphoric acid compound to correspond.

Since chloride invades an active ingredient even if it is the (1) and acid which has (3) functions, it can be said that it is unsuitable. [same]

[0035]Since flexibility of the electrode by which the water retention agent etc. were absorbed improves and contact resistance becomes smaller because an electrolyte membrane and a catalyst bed allot more densely when a unification electrode is used, internal resistance can be decreased. As a result, battery capacity improves. Movement of the proton from a hydrogen pole becomes easy, and electrode performance is stable. That is, by making a water retention agent etc. contain beforehand, since a hydrogen pole and an oxygen pole have flexibility, compatibility with an electrolyte membrane improves, a catalyst bed and an electrolyte membrane are unified more densely, movement of the proton from a hydrogen pole becomes easy, and an electrode reaction advances in an oxygen pole.

[0036]if it has the same character as an electrolyte membrane rather than retaining water, using a mere water retention agent etc. as a water retention agent etc., when becoming advantageous to an electrode reaction -- the point of productivity -- a thing -- since it is advantageous, the compound of a sulfonic acid system is good. And there is the optimal range in containing a water retention agent etc. in an electrode catalyst layer, and since gas diffusion nature will be checked if a large quantity is made to contain, the porosity which contributes to an electrode reaction must be secured. That is, since gas diffusion nature will be spoiled and degradation will be caused if the rate of occupying to the fine pores in an electrode catalyst layer increases in making a water retention agent etc. contain, there is a limit from self. In the case of sulfuric acid etc., the water retention agent etc. were 10 (mg/cm²).

[0037]Since molecular size is small and the hydrogen supplied to a hydrogen pole about porosity has good diffusion, diffusion of gas is easy in porosity being lower than an oxygen pole, and supply of gas does not become poor. It is important to raise porosity, since the diffusibility of oxygen is low and reactivity is also low, and to supply sufficient quantity in an oxygen pole. However, there is an appropriate range in the porosity of an electrode, if porosity is too low, the diffusibility of gas will fall and an electrode reaction will not advance. If porosity is too high, the electrical resistance of an electrode catalyst layer will become high, further, it is easy to dry a catalyst bed with distributed gas, maintenance of the usable area of a reaction field becomes difficult, and electrode performance stops being revealed. Therefore, there is an appropriate range in porosity, according to the result of examination, the direction where 35-60 (%) have [at] good 40-65 (%) grade in an oxygen pole, and made the porosity of the oxygen pole higher than a hydrogen pole more than 5 (%) is effective in a hydrogen pole on the water balance between two poles, but. In order to raise electrode performance, more than 10 (%) is suitable.

[0038]

[Effect of the Invention]In this invention, the activity of the air (oxygen) pole of a solid polymer electrolyte type hydrogen-air (oxygen) fuel cell can improve more nearly substantially than the conventional thing.

Therefore, battery capacity is improved by leaps and bounds.

Therefore, it is effective in the ability to provide a polymer electrolyte fuel cell with the highly efficient characteristic in early stages of power generation.

[Translation done.]